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AUTHOR Waetjen, Walter B.
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ABSTRACT

A common assumption is that boys are innately superior in analytical and quantitative skills and girls are superior in verbal skills. Research indicates, however, that these assumptions hold true only at certain times in the life cycle of each sex. There is evidence that cultural attitudes, rather than innate sex differences, account for differences in achievement. Males are found to like mathematics if their parents approve of mathematics education, but girls' attitudes are negative under the same condition. The more theoretically oriented teachers (male and female) are, the better are boys' attitudes toward mathematics. Many tests of aptitude or achievement are biased in favor of one sex or the other. This is due to the kinds of questions asked, the manner in which test scores are interpreted or the conditions of test-taking, which sometimes distort results, since boys perform more poorly in stress-producing situations. Attempts of testmakers to obscure differences in performance by boys and girls run counter to the effort of parents and teachers to instill different attitudes and motivations in each sex. Research indicates that only minimal differences in ability and achievement between the sexes can be attributed to physiology. (Author)

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SEX DIFFERENCES IN LEARNING: SOME OPEN QUESTIONS

Dr. Walter B. Waetjen
President, Cleveland State University
Cleveland, OH

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SEX DIFFERENCES IN LEARNING: SOME OPEN QUESTIONS

Problem solving and cognition are at the center of intellectual activity, whether that activity involves answering a question in the classroom, analyzing the platform of a political party, rebuilding an automobile engine, or borrowing money from a bank.

Everyone develops certain cognitive strategies, that is, ways of thinking by which they handle, organize, store, and recall information. Cognitive strategies determine and govern the amount as well as the organization of information that is available to a person. Although we know something about what goes into cognition, we know very little about what might affect differences in cognition between the sexes.[1] Cognitive strategies evolve, at least in part, as a function of individual personality development, so we infer that the differential socialization of males and females has the net effect of predisposing each sex toward certain cognitive strategies rather than others. Strategies for learning become enduring aspects of the manner in which individuals solve problems. The greater aggressiveness of the male is presumed to be a strong contributing factor underlying the better analytical skills of men and boys. Early in life aggressiveness is built into the personality makeup of the male; this is probably why boys initiate more queries and make more declarative statements in the classroom.[2] If one of the goals of the school is to develop analytical thinking skills then teachers should assist

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girls in acquiring this so-called unfeminine behavior.

As a group, girl babies talk earlier than boy babies; in school girls talk more than boys. The verbal skills that girls bring to school are demonstrated in almost all testing situations.[3] Do girls have an innate capacity for superior verbal skills, or do they develop this skill because the home or school rewards them for it?

One study found girls from the fifth through seventh grades to be superior to boys in language usage -- grammar -- and to have better study skills. In vocabulary and reading comprehension girls were ahead of boys in the fifth grade, but not in the sixth or seventh.[4] The boys, however, excelled in tests of arithmetical skill. Are these differences a result of a true sex difference or simply a reflection of cultural attitudes? The cultural view of intellectual differences was strongly supported by Kagan and Moss at the conclusion of their longitudinal studies:

> "Each individual has a cognitive picture of the person he would like to be and the goal states he would like to command -- an idealized model of himself. . .It would appear that the desire to be an ideal male or ideal female as defined by the individual, comprises an essential component of everyman's model. Thus the position of a response on a cognitive dimension ranging from highly masculine to highly feminine is a primary determinant of its acceptability and, therefore, of its probability of occurrence.[5]

Since boys expected to be better problem solvers than girls they are expected to excel in arithmetic.[6] But studies of arithmetic achievement give highly conflicting -- and confusing -- results. Some recent tests of

arithmetic achievement show either no difference between boys and girls, or only a slight superiority for boys -- depending on the test and the grade in which it was given. Tests in one suburban school system showed boys to be significantly superior to girls in understanding arithmetic concepts in seventh grade[7] and better than girls in high school.[8] In knowledge of the vocabulary of mathematics, girls outscored boys in grades four, five, and six. In arithmetical computation the girls again outscored boys, but in arithmetical concepts and applications the fifth and sixth grade boys did better than girls. An interesting sidelight of this analysis was that both boys and girls did less well in computational skills in 1968 than in 1930, thus raising questions as to whether the "new math" is increasing some kinds of understanding at the expense of proficiency in ordinary arithmetical computation.[9]

A careful and heavily studied program designed to identify youngsters with a very high aptitude for mathematics, and to determine what kinds of instructional procedures would encourage the development of their extraordinary potential showed that, in any pool of candidates, there were far more boys than girls. The fact that there were many more boys than girls in this exceptionally able group must not obscure the fact that there were some girls as able as the most competent boys. But why were there more boys than girls? The researchers say that the predominance of boys must be attributed to the differential treatment accorded boys and girls. ". . .

parents give boys such gifts as microscopes, telescopes, science kits and reference books more often than they give such presents to girls." And furthermore, "There is evidence in the published research that girls tend to avoid mathematics courses partly because they do not perceive such training as relevant to their anticipated vocational activities." The researchers conclude that "a full-scale investigation of what makes individual girls excel in mathematics may hold the key to understanding the dynamics of female psychological development in our culture."[10]

It seems that many factors play a part in the development of quantitative reasoning. Over a number of years, studies of entering freshmen at the University of California have shown that students of either sex from two child families have higher quantitative scores if the sibling is male. Other studies, too, have shown that "having a brother for a sibling helped both younger and older in a two child family."[11]

Parental attitudes appear to play a significant role in a child's mathematical achievement. Boys were found to like mathematics if their parents approved of mathematics education for them, and if the parents felt that learning mathematics aided their intellectual development. Even if their parents valued mathematics education, girls' attitudes were negative, but approval of competition in schooling produced positive attitudes toward math in both boys and girls.[12] Among boys, fathers' expectations of high achievement was a more significant factor than mothers' expecta-

tions. There appears to be an association between fathers' views of masculinity and sons' achievement in mathematics.[13] The absence of the father for extended periods of time during early childhood has been shown to be related to lower mathematical scores for both sexes. But if the father was absent for a short period during the son's adolescence, the boy's scores in mathematics were higher than if the father was always at home.[14]

There seems to be a significant relationship between boys' attitudes toward arithmetic and teachers' style of classroom presentation, regardless of the teacher's sex. One study showed that the more theoretically oriented and the more involved the teachers were, the better were boys' attitudes toward mathematics.

This study also reported that the cumulative effect of teacher on student was greater when the teacher and pupil were the same sex.[15] If the identification hypothesis holds, then the fact that most elementary teachers dislike arithmetic -- and that most such teachers are women -- has implications for girls' negative attitudes and poorer scores in arithmetic.[16]

Whether influenced by the attitudes of parents, peers, or teachers, many girls see mathematics as a subject for boys. This cultural bias affects girls' achievement in mathematics, and may be the cause of the average lower scores in quantitative reasoning skills among females. Kagan summarizes the data regarding the role of personality in the development of quantitative reasoning skills when he says:

> "It is well documented that problems requiring analysis and reasoning, especially spatial reasoning, science, and mathematics problems, are viewed by both sexes as more appropriate for boys than for girls. As might be expected, girls perform less well on such materials. . . The typical girl believes that the ability to solve problems in geometry, physics, logic, or arithmetic is a masculine skill, and her motivation to persist with such problems is low. Her decreased involvement reflects the fact that her self-esteem is not at stake in such problems. In some cases she is potentially threatened by the possibility that she might perform with unusual competence on such tasks, for excellence is equated with a loss of femininity."[17]

The idea that something is more feminine than something else has been the basis for developing measures of femininity and masculinity. That feminine and masculine are dubious grounds for measuring patterns of behavior is increasingly clear to researchers. Nevertheless, one effort to see if masculinity was related to problem solving showed that male students who majored in science had higher masculinity scores than women science majors, but men nonscience majors also had higher scores than the female science majors.[18] One intriguing study reported that femininity scores for women math majors in college were higher than for female education majors.[19]

Cognitive functioning does not take place in a vacuum. If one is disturbed or troubled, one's problem solving ability is apt to be impaired. The influence of psychological state on cognition differs according to sex and age. In preadolescence or early adolescence psychological difficulties seem to interfere with boys' cognition, while girls seem not to be so affected until middle adolescence. Researchers

reporting these findings also noted that boys and girls seemed to respond to different cultural expectations.

> "Although both sexes may think an equal number of 'bad thoughts,' the threat to the individual's concept of self-worth instigated by these thoughts may be far from equal for boys and girls. If morbid and aggressive fantasies tend to be less threatening to boys, their occurrence would be less likely to set off a chain of introspective events interfering with rational cognitive functioning. Girls on the other hand, might be less capable of ignoring this 'internal disorder,' and accordingly there would be greater interference with rational cognitive functioning."[20]

An alternative hypothesis might be that it is permissible for girls to admit morbid thoughts, and even to dwell on them, while boys would think it unmanly to be introspective about such fantasies.

In a study of differences between the sexes in applying knowledge, it was found that high school boys had superior scores but that this was not due to practice effects, reading preference or activities, IQ, previous knowledge, personal traits, or reading comprehension. The boys' higher scores reflected their superior ability to apply knowledge or skill when confronted with a new situation. One might suppose that this superior ability to transfer learning would cause males to achieve better in the educational environment. Yet, we know that this is not the case, at least as far as their grades are concerned.

Investigation of the level of conceptual reasoning attained by boys and girls from different socioeconomic groups revealed that 1) higher social class was associated with ability to conceptualize at a higher level,

and 2) female scores were significantly higher than male scores. At the same time, there was a wide variation in male scores on conceptualization among middle class junior high students.[21] The results of a study conducted by Buddeke indicate a sex difference in patterns of conceptualization. In this study one hundred high school boys were equated with one hundred girls on the basis of identical scores on standardized algebra tests.[22] While the girls tended to keep content areas relatively separate from each other and perceived direct relationships among the elements of a given area of algebraic study, the boys solved problems through a recognition of broad relationships among content areas. This study demonstrates that males and females seem to put ideas together differently. We are nagged, of course, by questions raised by Kagan's remarks: is it the task that produces the different strategies? If boys and girls were given other kinds of problems would they differ as much?

Differences in cognitive patterning may be an important clue to male superiority in applying knowledge. One investigator found that, when given verbal tasks requiring the synthesis of ideas, boys were always better than girls.

On a test measuring inferences drawn from maps, girls were better than boys in all-black groups, while in lower class white groups only the more disadvantaged girls were superior to the boys; boys from a suburban environment were superior to all others. Contradictory

results by social class and racial group suggest that environmental factors may play as great a role as any innate differences in the development of cognitive skills.[23] Stafford studied the relative influence of heredity and environment on differences in quantitive reasoning ability. After examining a vast amount of data regarding achievement and attitude, he looked at cross-cultural studies and found consistent male superiority. Twin studies revealed similar sex differences. His conclusion:

> "In general there is an underlying hereditary component for a proficiency in quantitative reasoning which fits the sex-linked recessive model fairly well. This 'have' or 'lack' quality results in two normal curves. . . Whether an individual is placed in the top curve or the bottom curve would, therefore, depend largely upon the effect of a host of environmental components. . . We, therefore, cannot discount the very important interaction effects of environment (such as home life, choice of school, adequacy of teacher, proper attitude, and family support) with genetic endowment which result in students with varying degrees of quantitative reasoning ability."[24]

The influence of the genetic component is not understood. In persons with an extra X chromosome, or in those having only one X chromosome and no Y chromosome, the larger "female" component leads to lessened ability in quantitative reasoning, even though those studied had an IQ range similar to that of the normal population. Persons with only one X chromosome and no Y had a distinctive deficit in perceptual organization, a kind of "space-form blindness."[25]

In this section we have presented a wide range of conflicting data and divergent hypotheses about sex differences in learning so that

the reader might be aware that this remains a highly controversial area. So far the researchers have provided only inconclusive evidence about the causes of any intellectual or cognitive differences that may exist between the sexes,[26] but they have learned a good deal about the way schools mark some ways of thinking as masculine and others as feminine. As young people learn their sex-identity, they perforce take up the sex-appropriate intellectual strategies which may in fact have little to do with any innate predisposition to think or solve problems in one way or another. Schools must do a far better job of supporting intellectual ability in boys and in girls, so that both may feel free to explore the world of ideas freely and productively. So far, intellectual vitality and curiosity seem to be male prerogatives.

Tests and Test-Taking

In school, college, business, and even in the armed services, tests are critical measures of success. The person who does well on tests usually has a wider range of choices and alternatives available to him or her. One must be wary of accepting test scores at face value, however. Many tests of aptitude or achievement are biased in favor of one sex or the other. The bias may inhere in the test itself (for example, in the kinds of questions asked), or it may derive from the manner in which the test scores are interpreted. For instance, a test manual for

one standardized test allowed the combining of scores for boys and girls into one table of norms in the areas of verbal, numerical, and abstract reasoning, as well as language usage. This despite the manual's statement that in every grade girls score higher than boys in language usage.[27] Clark used the California Test of Mental Maturity and the California Achievement Test to ascertain if there were differences in abilities and achievement of children in grades three, five, and eight.[28] The former test was supposed not to be biased in favor of either sex, but analysis of test scores in language, mechanics of English, and spelling revealed consistently higher scores for girls. This was true even after he removed from the data such differences as could be attributed to chronological age and mental age.

In addition to bias in tests and test scoring, the conditions of test taking may distort the results. Boys do less well than girls in certain stress-producing situations. Reduce the threat of the test situation, and boys' scores would go up. Girls, on the other hand, may need the spur of anxiety to perform well in test situations; numerous studies indicate that girls and women express more anxiety in many situations.[29] Males, however, seem to hide their anxiety, for they believe it is not masculine to indicate this state.

But many factors inhibit girls from trying to do their best. Over a decade ago McClelland, who has contributed some of the major theoretical and experimental findings about achievement, commented:

> "Women do not show an increase in Achievement scores as a result of achievement-involving instruction. . . Why then don't women's scores increase under experimental arousal?

> This is the puzzler. Two possible explanations -- invalidity of the scoring for women, scores too high to go higher -- have been eliminated. Apparently the usual arousal instructions simply do not increase achievement striving in women. . . ."[30]

An experiment was designed to produce higher achievement scores among girls selected for outstanding achievement. These girls were aroused only in response to pictures of girls achieving, not boys. But girls who had not been successful in school work showed an increase in their achievement scores in response to pictures of males. The conflicting evidence can hardly be explained, say the researchers, by any simple theory based on a single motive.[31]

The drive to achieve inevitably leads to competition with others, and competitiveness is an attribute which is not generally rewarded among girls. Thus girls may deny their actual achievements and may consistently choose their life goals in terms of a stereotype of the passive, dependent, slightly stupid women. Males respond to achievement motivation quite differently, and are willing to engage in combat and competition at a very early age. Yet under great pressure as in test-taking, boys demonstrate more anxiety and lower achievement.[32] Men may get further because of their greater drive, but it is a fragile and vulnerable personality attribute. Women may not get as far, but they have far lower expectations of themselves -- in fact, negative expectations. For a girl, to succeed is to fail. No wonder some able students regard their test scores with cynicism.

They realize that these are not true measures of what they know -- or what they could know.

Is It True That Boys Are Smarter Than Girls?

If being smarter means getting good grades in school, then girls are smarter than boys; if intelligence is measured by achieving recognition through leadership in government, the arts, business, or almost any other field of endeavor, then there is no question that men far outdistance women. Yet no one believes that school grades or positions of leadership are sufficient evidence to judge one sex as more or less intelligent than the other. Girls appear to win the IQ race early in life, and boys win later on. If achievement is not a reliable measure of intelligence, what then is? Is the IQ test an objective measure that we can rely upon?

IQ tests were carefully constructed to eliminate items which favored one sex over the other. When Terman undertook to refine the intelligence testing procedures of the French psychologists, Binet and Simon, he excluded items which might demonstrate that either sex was superior or inferior; his basic assumption was that intelligence was equally distributed regardless of sex. Although subsequent studies have shown that IQ is not constant over time, that it is difficult to identify "inborn" mental abilities, that cultural, academic, and other experiences can influence IQ, test makers continue to measure IQ as

they did in Terman's time.[33]

> ". . .there is still not available any test of over-all 'intelligence' which will permit except accidentally of differential performance by the two sexes, although it is readily apparent that boys and girls of normal upbringing in our society have different sorts of experiences and we have different expectations of them, even in the schools. It is not likely that an item would be dropped from a mechanical assembly test because girls performed less well on it than boys, yet the intelligence test-constructors will not permit us to discover whether there are important differences we should know about in the intellectual functioning of the two sexes. . .Terman simply stated that he eliminated tests which would be 'relatively less fair to one sex than the other,' seeing no need for further justification. . . Would it not have been equally appropriate to eliminate items on which there was differential performance for Negro and white children?"[34]

If this rationale were accepted, any item which differentiated among ethnic groups or groups of different socioeconomic status would be eliminated. As the authors cited above say rather testily: "The continuing attempt of test makers to obscure differences in performance by boys and girls runs counter to the constant and conscious effort of parents, teachers, and society at large to instill in growing children the very different attitudes, motivations, and behaviors expected of each sex."[35] Longitudinal data show that IQ tests require an empathetic relationship between an examiner and the one being tested, a situation with different meanings for boys and girls. Analysis of IQ data can be misleading because patterns of intercorrelations among subtests vary by sex. "It is likely that many studies in literature or in a file drawer would have led the

investigator to draw different conclusions if separate analysis had been made for males and females."[36] If one sex is "smarter" than the other, IQ tests are the last place to find the evidence.

School-administered tests of IQ are probably the least reliable measures of ability. Generally the tests given in school are group tests, administered to a large number of pupils at one time in one place. Since we know that boys and girls have a rather different orientation to school tasks, it is not surprising that girls perform better on these tests. They pay attention to the directions, are less easily distracted, and in general have a higher level of verbal functioning. Thus any aspect of the test that involves reading would automatically favor the girls. As boys learn the school game, and as slower youngsters drop out, measured intelligence of boys equals and sometimes exceeds that of girls. Such factors as a child's dependency on the teacher or development of autonomous behavior may affect test results.[37]

In the early school years girls do better on tests of general intelligence, but by adulthood males do better or females test less well.[38] During late childhood and adolescence developmental differences show up: girls who started out as the brightest slow down in their mid-years, while boys who started out being quite clever get smarter as they go along, according to one longitudinal study. There is some question as to whether the very bright girls found out that being bright did not pay, and suppressed their real ability, but tests do not yet tell us this.[39]

After doing extensive longitudinal studies, Kagan and Moss concluded that boys' scores at age ten are a better indicator of intellectual abilities in adulthood than the scores obtained when they are six years old. Boys with a strong desire to master intellectual skills gained in IQ score during the early years of school, while those with low mastery motivation remained stable or showed slight decreases in IQ score. This difference in the predictive power of the IQ test at age six versus age ten did not occur for the girls. ". . . twice as many boys as girls had major increases in IQ scores during the school years."[40]

If this research is correct, then parents and teachers would be well advised to treat IQ scores, particularly those of young boys, with extreme skepticism. Any kind of tracking or grouping system used by a school must be scrutinized with care, since neither IQ tests nor grades appear to be very reliable indicators of student ability; this is particularly true among younger boys.

There is striking evidence that the adult pattern of achievement is decisively and perhaps irreversibly influenced by parental attitudes during very early childhood. Longitudinal studies show that a girl benefits when her mother does not dominate or oversee too closely, but a close and warm relationship with mother is very beneficial for a boy, particularly in regard to verbal test scores. Girls are more apt to have lower tested aptitudes if their early family life was marred by parental conflict. Boys showed higher aptitudes when their fathers demonstrated concern

about their educational achievement, when the father's income was relatively high. A girl's mental development appears to flourish when she has a father who is friendly but not overly demonstrative.[41] One study showed that even among ninth grade girls who achieved good grades there was a belief that their parents had higher educational aspirations for boys than girls.[42]

Boys are referred for special attention due to "mental retardation" more often than girls,[43] but there is no convincing evidence that there are more stupid boys than girls. There is greater variability in intelligence among boys than girls. That is, there will be a larger spread between very bright boys and very slow boys. Does this mean that girls -- even very slow ones -- put their intelligence to work, but are not motivated to push themselves to their limits at the highest end of the continuum? Boys start off with built-in handicaps -- frailer physique, less verbal stimulation, physiologically behind girls until after adolescence -- which may reinforce tendencies to lag behind. But as the boy matures, social and physiological forces support his motivation to excel.[44]

To some extent, intelligence lies in the eye of the beholder. In one recent study, young men and women were presented with an "authoritative" statement about matters of fact. For one group of subjects the author of the statement was said to be a woman, while the other group was told it had been authored by a man. Both men and

women subjects had more confidence in the report supposedly written by a man.[45] Both sexes think men are better at almost any intellectual task, even in traditionally female activities.

There may be food for thought in the research that found that boys and girls react differently to success or failure. Boys are inclined to consider academic success to be due to their own efforts, but to see failures as the result of bad luck or external causes. Girls express feelings of greater control over their academic performance, but this is apt to be related to failure rather than success. Girls feel guilty and blame themselves for failure, but consider outside forces or luck more significant when accounting for success.[46]

If one assumes that children learn their sex roles through a process of identification with persons of the same sex, then it would follow that boys adopt "male" modes of thinking and girls "female" modes. After studying the data on sex-role models and the theories available at the right time and in the right way, "The little girl acquires a cognitive style that primarily involves (1) a personal relationship, and (2) imitation rather than restructuring the field and abstracting principles. In contrast, the little boy acquires a cognitive style that primarily involves: (1) defining the goal, (2) restructuring the field, and (3) abstracting principles."[47] To substantiate this view, Lynn points out that girls can learn about life around them by observing their mothers; they do not have to make any

special effort to restructure the field. Boys, however, must learn to be boys through a specific intellectualizing -- they must figure out what kind of behavior is acceptable and what is "being a sissy." The masculine learning method inculcates restructuring the field as a learning principle.[48] What kind of cognitive style would boys learn if they were raised by men only? Would the necessity for learning how to restructure the field disappear?

In answer to our original question, "Are boys smarter than girls?" it would appear that females may be the more intelligent sex, and that there are more males with low IQs. Girls receive higher grades than boys, and consistently outperform them scholastically, but boys have a greater sense of personal power.[49] In adult life, one might therefore conclude that intelligence may be less important than the conviction one can succeed.

Who Is More Creative?

The absence of women from among those who have achieved greatness through creative pursuits has been attributed to lack of opportunity, although some observers believe that there may be an innate difference in creativity between the sexes.

Though there is considerable interest in creativity and its nurturance, little research has been done on sex differences in creativity. Torrance reviewed 142 studies, and found only one that indicated any

analysis by sex.[50] The limited amount of research regarding creativity and sex differences has not, however, limited speculation on the subject.[51] Neither sex appears to be consistently superior in creativity during childhood. Teachers report that during adolescence boys are far more resistant than girls to many kinds of "creative endeavors such as writing poetry. Girls are heavily represented in school orchestras and art classes. But in adulthood, males dominate the graphic arts and performing arts. Clearly, something other than "innate" capacity or even interest is at work here.

In school boys receive more encouragement for creativity than girls. Teachers reward boys almost three times as much as girls for divergent contributions. A cross-cultural study found that boys, whether living in Bombay or Minneapolis, have more opportunities to develop their creativity than girls.[52] Even if girls are not as creative as boys, they show a much higher correlation of IQ with creativity.[53] Experimental efforts to raise girls' aspiration levels suggest that boy-girl differences in creativity might be affected by changed treatment.[54] So far there is no hard evidence that boys and girls are innately different in the <u>potential</u> for creativity.

So far in this chapter we have reviewed the evidence regarding sex differences in learning, intelligence, and creativity. The evidence is murky. The findings of researchers indicate that only minimal differences in ability and achievement between the sexes can be attributed

to physiology. We find that the human animal, male or female, is almost infinitely flexible. If we want intellectual boys and girls and creative girls as well as boys, then institutions and parents must make it possible.

Dr. Walter B. Waetjen
President
Cleveland State University
January 24, 1977

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